

P. ENT COOPERATION TREA

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C.20231
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 11 August 2000 (11.08.00)	
International application No. PCT/GB99/04188	Applicant's or agent's file reference CPW 50721/WO
International filing date (day/month/year) 10 December 1999 (10.12.99)	Priority date (day/month/year) 08 January 1999 (08.01.99)
Applicant DAVIES, Raymond	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

17 July 2000 (17.07.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer Pascal Piriou</p> <p>Telephone No.: (41-22) 338.83.38</p>
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PATENT COOPERATION TREATY

PCT

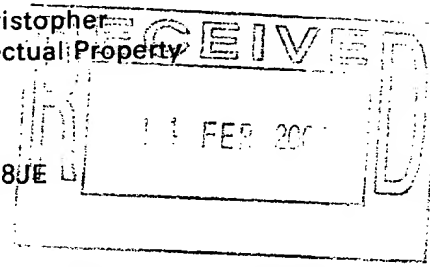
NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

GRATWICK, Christopher
ICI Group Intellectual Property
P.O. Box 90
Wilton
Middlesbrough
Cleveland TS90 8JE
ROYAUME-UNI



Date of mailing (day/month/year) 08 February 2000 (08.02.00)	
Applicant's or agent's file reference CPW 50721/WO	IMPORTANT NOTIFICATION
International application No. PCT/GB99/04188	International filing date (day/month/year) 10 December 1999 (10.12.99)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 08 January 1999 (08.01.99)
Applicant IMPERIAL CHEMICAL INDUSTRIES PLC et al	

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
08 Janu 1999 (08.01.99)	9900314.7	GB	17 Janu 2000 (17.01.00)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Marc Salzman

Telephone No. (41-22) 338.83.38

003094786

PARENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

GRATWICK, Christopher
Synetix Intellectual Property
Department
Building N, Room 101, Chilton Site
P.O. Box 1, Belasis Avenue
Billingham
Cleveland TS23 1 LB
ROYAUME-UNI

Date of mailing (day/month/year) 14 July 2000 (14.07.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference CPW 50721/WO	
International application No. PCT/GB99/04188	International filing date (day/month/year) 10 December 1999 (10.12.99)

1. The following indications appeared on record concerning:									
<input type="checkbox"/> the applicant	<input type="checkbox"/> the inventor <input checked="" type="checkbox"/> the agent <input type="checkbox"/> the common representative								
Name and Address GRATWICK, Christopher ICI Group Intellectual Property P.O. Box 90 Wilton Middlesbrough Cleveland TS90 8JE United Kingdom	<table border="1"> <tr> <td>State of Nationality</td> <td>State of Residence</td> </tr> <tr> <td colspan="2">Telephone No. (01642) 432 710</td> </tr> <tr> <td colspan="2">Facsimile No. (01642) 436 146</td> </tr> <tr> <td colspan="2">Teleprinter No.</td> </tr> </table>	State of Nationality	State of Residence	Telephone No. (01642) 432 710		Facsimile No. (01642) 436 146		Teleprinter No.	
State of Nationality	State of Residence								
Telephone No. (01642) 432 710									
Facsimile No. (01642) 436 146									
Teleprinter No.									
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:									
<input type="checkbox"/> the person	<input type="checkbox"/> the name <input checked="" type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence								
Name and Address GRATWICK, Christopher Synetix Intellectual Property Department Building N, Room 101, Chilton Site P.O. Box 1, Belasis Avenue Billingham Cleveland TS23 1 LB United Kingdom	<table border="1"> <tr> <td>State of Nationality</td> <td>State of Residence</td> </tr> <tr> <td colspan="2">Telephone No. 44 1642 522252</td> </tr> <tr> <td colspan="2">Facsimile No. 44 1642 523077</td> </tr> <tr> <td colspan="2">Teleprinter No.</td> </tr> </table>	State of Nationality	State of Residence	Telephone No. 44 1642 522252		Facsimile No. 44 1642 523077		Teleprinter No.	
State of Nationality	State of Residence								
Telephone No. 44 1642 522252									
Facsimile No. 44 1642 523077									
Teleprinter No.									
3. Further observations, if necessary:									
4. A copy of this notification has been sent to:									
<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned								
<input type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned								
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:								

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer R. Chrem Telephone No.: (41-22) 338.83.38
---	--

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

To:

ICI Group Intellectual Property
Attn. GRATWICK, C.
PO Box 90, Wilton, Middlesbrough
Cleveland, TS90 8JE
UNITED KINGDOM

Date of mailing
(day/month/year)

29/03/2000

Applicant's or agent's file reference

CPW 50721/WO

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/GB 99/ 04188

International filing date
(day/month/year)

10/12/1999

Applicant

IMPERIAL CHEMICAL INDUSTRIES PLC et al.

1. ☐ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Patrick Gehl

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference CPW 50721/WO	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 99/ 04188	International filing date (day/month/year) 10/12/1999	(Earliest) Priority Date (day/month/year) 08/01/1999
Applicant IMPERIAL CHEMICAL INDUSTRIES PLC et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

1



None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

A catalyst support structure e.g. for use in an ammonia oxidation reactor, comprising a series of primary supports (19) disposed above a catalyst bed, a lattice assembly disposed beneath the catalyst bed and on which the catalyst bed rests, said lattice assembly being suspended from the primary supports (19) by suspending means (27) extending through the catalyst bed. Preferably the support structure includes a static start-up burner arrangement in the form of one or more perforated tubes (24) adjacent the primary supports (19).

INTERNATIONAL SEARCH REPORT

Intern. Appl. No.

PCT/GB 99/04188

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B01J8/02 B01J8/00 C01B21/26 C01B21/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B01J C01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 482 946 A (SHIRK ROBERT M) 9 December 1969 (1969-12-09) column 3, line 16 - line 50 claims 1-7; figures 1-5 ---	1-4, 14, 15, 20
A	US 4 195 064 A (BETTEKEN JOSEPH C ET AL) 25 March 1980 (1980-03-25) column 5, line 60 - column 8, line 37 claims 1-7; figures 5-10 ---	1, 3-6
A	FR 2 253 554 A (BRITISH PETROLEUM CO) 4 July 1975 (1975-07-04) page 5, line 33 - page 7, line 15 figures 1-4 ---	1, 14
A	DE 37 31 988 A (STEINMUELLER GMBH L & C) 6 April 1989 (1989-04-06) the whole document -----	11, 12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

21 March 2000

Date of mailing of the international search report

29/03/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Vlassis, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/04188

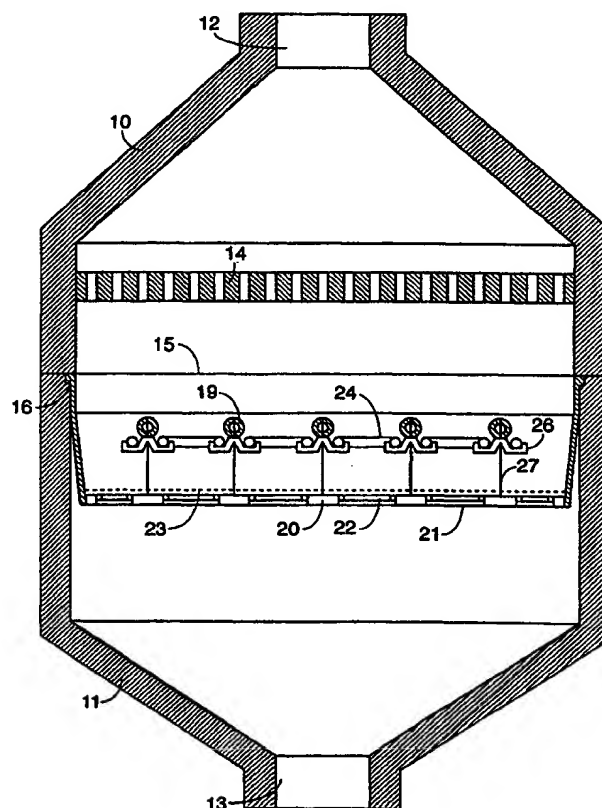
Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3482946	A	09-12-1969	NONE	
US 4195064	A	25-03-1980	NONE	
FR 2253554	A	04-07-1975	GB 1450715 A	29-09-1976
			AU 7572174 A	27-05-1976
			BE 823059 A	06-06-1975
			CA 1054513 A	15-05-1979
			DE 2457658 A	12-06-1975
			IT 1030885 B	10-04-1979
			JP 50090576 A	19-07-1975
			NL 7415392 A	10-06-1975
			SE 398977 B	30-01-1978
			SE 7415314 A	09-06-1975
			US 3977834 A	31-08-1976
DE 3731988	A	06-04-1989	NONE	

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : B01J 8/02, 8/00, C01B 21/26, 21/28	A1	(11) International Publication Number: WO 00/40329 (43) International Publication Date: 13 July 2000 (13.07.00)
(21) International Application Number: PCT/GB99/04188 (22) International Filing Date: 10 December 1999 (10.12.99) (30) Priority Data: 9900314.7 8 January 1999 (08.01.99) GB (71) Applicant (for all designated States except US): IMPERIAL CHEMICAL INDUSTRIES PLC [GB/GB]; Imperial Chemical House, Millbank, London SW1P 3JF (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): DAVIES, Raymond [GB/GB]; 9 Limpton Gate, Yarm, Cleveland TS15 9JA (GB). (74) Agents: GRATWICK, Christopher et al.; ICI Group Intellectual Property, P.O. Box 90, Wilton, Middlesbrough, Cleveland TS90 8JE (GB).		(81) Designated States: AU, BR, CA, CN, IN, JP, KR, NO, RU, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: CATALYST SUPPORT**(57) Abstract**

A catalyst support structure e.g. for use in an ammonia oxidation reactor, comprising a series of primary supports (19) disposed above a catalyst bed, a lattice assembly disposed beneath the catalyst bed and on which the catalyst bed rests, said lattice assembly being suspended from the primary supports (19) by suspending means (27) extending through the catalyst bed. Preferably the support structure includes a static start-up burner arrangement in the form of one or more perforated tubes (24) adjacent the primary supports (19).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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Catalyst support

This invention relates to a catalyst support and in particular to supporting catalysts for reactions effected at relatively high temperatures, especially in the manufacture of nitric acid by the oxidation of ammonia.

5 Heretofore in ammonia oxidation processes, the catalyst, often in the form of a stack or wad of wire gauzes or meshes of the active material, for example platinum, often in combination with other precious metals such as palladium, is supported on a lattice of steel beams disposed across the reaction vessel below the catalyst layer. Under conventional operating conditions, the reactants, e.g. a gaseous mixture of ammonia and air, are fed at an
10 elevated temperature, typically in the range 100 to 300°C, to the vessel space above the catalyst. On passage through the catalyst, the reaction takes place: being a strongly exothermic reaction, the gas temperature rapidly increases, typically to a temperature in the range 800 to 950°C. Consequently the support lattice is exposed to such high temperatures. The reaction vessel is typically 2 to 6 m in diameter and so in order to withstand the high
15 temperatures while supporting the catalyst without undue deformation, it has generally been necessary construct the lattice from relatively closely spaced steel beams of considerably depth, typically 15 to 30 cm, extending across the vessel. Such structures are heavy and, since they have to be constructed of materials that can withstand the harsh operating conditions, are expensive. Conventionally the lattice has been of a welded "bottle crate"
20 construction. Not only is such an arrangement heavy and expensive but it is prone to buckling and damage: being of welded construction renders repair difficult and expensive.

We have realised that much lighter, and hence cheaper and more easily handled, support structures can be employed if the primary support is from above the catalyst bed where the prevailing conditions are not so extreme.

25 Accordingly the present invention provides a structure for supporting a catalyst bed in a vessel comprising a series of primary supports extending across the vessel and a lattice assembly carrying the catalyst bed disposed beneath the primary supports and suspended therefrom via suspending means extending through the catalyst bed.

The invention is illustrated by reference to the accompanying drawings in which:

30 Figure 1 is a diagrammatic vertical section through an ammonia oxidation reactor,
 Figure 2 is a plan of the reactor with the upper shell member removed;
 Figure 3 is a section along the line III - III of Figure 2;
 Figure 4 is a plan of the base assembly of Figure 3 with the primary support member assembly and cover plate removed,
35 Figure 5 is an isometric sketch of part of the base assembly;
 Figure 6 is an enlarged plan of part of Figure 2 showing four of the base assemblies and the grid assembly supported thereby;

Figure 7 is an elevation of part of the grid assembly;

Figure 8 is a section along the line VIII - VIII of Figure 7 showing an adjacent grid assembly in broken lines;

5 Figure 9 is a section of part of the skirt illustrating the method of supporting the grid assembly at the walls of the vessel;

Figure 10 is a plan view of the arrangement of Figure 9;

Figure 11 is a view similar to the lower part of Figure 3 showing an alternative embodiment;

10 Figure 12 is a view similar to Figure 10 illustrating the method of supporting the grid assembly at the walls of the vessel for the alternative embodiment;

Figure 13 is a view similar to that of Figure 8 showing the alternative embodiment;

Figure 14 is a view similar to Figure 3 showing an alternative start-up burner arrangement;

15 Figure 15 is a view similar to Figure 14 showing another start-up burner arrangement.

Referring to Figure 1 an ammonia oxidation reactor consists of an outer shell of generally circular cross section formed as upper and lower shell members 10, 11, provided with a reactants inlet port 12 and a reaction products outlet port 13 respectively. The upper shell member is provided with a perforate diffuser plate 14 extending across the shell. The diameter of the reactor is typically about 4 m.

20 The lower shell member carries a skirt 15 located round the interior periphery of the vessel by means of an outwardly extending flange resting in a rebate 16 in the upper rim of the lower shell member 11. Skirt 15 has an upper cylindrical portion and then an inwardly tapered, i.e. frusto-conical, portion 17. Since, in operation the lower portion of the skirt is liable to be at a much higher temperature, e.g. about 900°C, than the upper portion which is typically at about 25 300°C, the conical configuration permits some differential thermal expansion of the lower portion of the skirt relative to the upper portion.

As shown in Figure 2, a number of channel sectioned supports 18 are welded to the upper part of the conical portion of the skirt in chordally disposed pairs. Typically there are five pairs of supports 18. Each pair of channel section supports carries a primary support 30 member 19. These primary support members carry a lattice assembly: since the primary support members are located above the catalyst bed, they are disposed in the relatively cool part of the reactor and so do not need to be made from a material that can withstand the high temperatures encountered in or below the catalyst bed. The primary support members may be solid or hollow and may be of any convenient cross section. However they are preferably 35 pipes, since pipes of suitable material and size are readily available. The number, configuration and size of the primary support members required will depend on the size of the reactor and the load to be supported. Typically with a reactor diameter of 4 m, there may be

used five primary support members in the form of pipes of diameter about 10 cm spaced at about 80 cm intervals.

The lattice assembly comprises a plurality of base assemblies 20 connected by pairs of grid supports 21 and a plurality of grid assemblies 22 (only one of which is shown in Figure 2) carried by the grid supports 21. As described hereinafter, the grid supports 21 are attached to the lower frusto-conical configuration portion 17 of the skirt member 15.

A number of base assemblies 20 are suspended from each primary support member 19. Typically these assemblies are disposed in a square configuration at a pitch corresponding to the spacing of the primary support members 19. The catalyst bed (shown by the dotted line 23 in Figure 1 and only shown in part in Figure 2) is disposed on top of the base and grid assemblies. Although preferred, it is not necessary that the base assemblies 20 are disposed in a square pattern: thus they may be disposed in other configurations, e.g. rectangular or triangular patterns.

Although the base and grid assemblies are located in the high temperature region of the reactor, the loads borne by the individual assemblies are relatively low. In particular there are no individual load bearing members extending across the whole span of the reactor in the high temperature region and so massive construction to withstand large deformation loads is not necessary. Consequently the mass of high temperature resistant materials is reduced.

Whereas in a conventional ammonia oxidation reactor, the reaction is initiated by heating the catalyst bed by means of a rotating burner directing a flame obtained by combusting a combustible gas e.g. hydrogen on to the catalyst bed, such a construction is not suitable in the present invention as any such burner would need to be disposed above the primary support members and so subject them to localised high temperatures during start-up.

In the present invention this problem is overcome by providing a static start-up burner arrangement in the form of one or more tubes adjacent the primary support members and means to supply a combustible gas thereto. The tube, or tubes, is provided with perforations (not shown) at intervals so that a flame can be directed down and, preferably, outwards from the tube on to the catalyst bed. As shown in Figures 1, 2 and 3, the start-up burner may comprise a single serpentine tube 24 adjacent the primary support members 19. For clarity, in Figure 2, this serpentine tube is shown part in full and part by dotted lines. A fuel gas, for example hydrogen, may be fed to the serpentine tube 24 through a suitable inlet pipe 25 shown dotted in Figure 2.

Referring to Figures 2 and 3, the serpentine tube 24 is supported on brackets 26 located at each secondary assembly suspension point. For clarity in Figure 2, the brackets 26 are shown only at the locations where serpentine tube 24 is shown by full lines. As shown in Figure 3, the brackets 26 and the base assemblies 20 are supported from primary support members 19 by tie rods 27. Although these tie rods are load bearing and subject to high

temperatures at their lower ends, they are in tension and so not subject to buckling loads. To permit adjustment during assembly of the whole catalyst support structure, the location of the base assemblies 20 relative to the primary support members 19 is preferably by means of threaded portions and nuts at the upper and/or the lower ends of the tie rods 27.

5 The base assemblies 20 are shown in more detail in Figures 3, 4 and 5. Supported by each tie rod 27 is a base member 28, which is preferably a casting to avoid the need for welds, and a cover plate 29. Where the base assemblies 20 are disposed in a square or rectangular configuration, each base member 28 is preferably of octagonal configuration and has inner and outer upstands 30, 31, arranged in pairs. For a square or rectangular configuration of base
10 assemblies 20, each base member 28 has four pairs of upstands.

Each outer upstand 31 is provided with a slot 32 through its wall. The inner and outer upstands are provided with two pairs of notches 33 in their upper surface (see Figure 5). Located in each pair of notches 33 is a hinge member 34 having rounded projections 35
15 engaging with the notches. Each hinge member 34 is thus able to pivot relative to the inner and outer upstands. When assembled, the cover plate 29 of the base assembly 20 acts as a keeper to retain the projections 35 of hinge members 34 in the notches 33 of the upstands.

Each hinge member 34 is also provided with a pin 36, positioned at a location below the axis of projections 35, projecting from the hinge member 34 in a direction perpendicular to the axis of the rounded projections 35. A grid support 21 having an elongated slot 37 at each
20 end is mounted on each pin 36 and extends through the slot 32 in the outer upstand 31. The grid support is thus supported by a pin 36 on a hinge member 34 pivoting in the base member 28 about an axis parallel to, but above, said pin. The grid supports 21 thus extend from the base member 28 in a direction parallel to the axis of the rounded projections 35. Each grid support 21 engages at its other end with a corresponding pin on a hinge member of an
25 adjacent base assembly or with a pin connected to the periphery of the lower portion 17 of the skirt 15. The mounting of the grid supports at the periphery of the skirt is described hereinafter with reference to Figure 9.

By virtue of the elongated slots 37, the grid supports 21 are free to move longitudinally with respect to the base members 28, and by virtue of the hinge members 34, are also free to
30 swing laterally to permit displacement of the grid supports 21 in the lateral direction. Since each pair of notches 33 in the upstands 30, 31 carries a hinge member 34 and each hinge member 34 carries a grid support 21, the base assemblies 20 are connected by pairs of grid supports 21 spaced apart from one another and free to move laterally and longitudinally relative to one another. The base assemblies 20, and hence tie rods 27, are thus not subjected to
35 thermally induced lateral stresses and so forces tending to give rise to buckling are minimised.

Referring to Figure 6, where four adjacent base assemblies 20 are shown connected by pairs of grid supports 21. A grid assembly 22 is shown located on the inner grid support of

each pair. The grid assembly comprises an outer octagonal ring member 38 dimensioned such that it can expand through thermal expansion without imposing undue forces on adjacent grid assemblies on the other grid supports of the grid support pairs and on the base assemblies 20. To avoid welds, the ring 38 may be simply be of bent metal construction. Ring member 38 is provided with downwardly extending locating lugs 40 which serve to position the grid assembly relative to the grid supports 21. Expansion of ring 38 thus causes the grid supports 21 to move longitudinally and laterally but, as previously described, because of the mounting of the grid supports 21 via hinge members 34 and elongated slots 37 in the ends of the grid supports 21, such longitudinal and lateral movement does not give rise to buckling forces on the base assemblies 20 and tie rods 27.

As shown in Figures 6, 7 and 8, the opposed sides of the ring member 38 are provided with a plurality of notches in the upper surface: The notches 41 in one pair of opposed sides serve to support rebated cross bars 42 which in turn have notches 43 which support rods 44. The ends of rods 44 are located in notches 45 in the other pair of opposed sides of ring member 38. The upper surfaces of the cross bars 42, rods 44, and ring 38 are preferably substantially co-planar with the upper surface of the cover plates 29. The notches, rebates on bars 42, and the lengths of the bars and rods are dimensioned such that relative movement is possible to accommodate thermal expansion. The number and spacing of the rods and bars will depend on the tolerable "sag" of the catalyst layer disposed above the grid assemblies. Generally, as hereinafter described, a wire mesh 46 is disposed on top of the grid assemblies to act as a support between adjacent cross bars and rods. Typically the spacing between adjacent cross bars and between adjacent rods is in the range 2 to 15 cm, particularly in the range 3 to 12 cm. It will be appreciated that it is not necessary that the spacing between adjacent cross bars 42 is the same as the spacing between adjacent rods 44.

In Figures 9 and 10, the mounting of the grid supports 21 at the periphery of the skirt is shown. In Figure 10, the mesh 46 is omitted for clarity. At the requisite locations, brackets 47 are welded to the lower conical portion 17 of the skirt. A pair of hinge members 48 are pivoted in each bracket about an axis parallel to the length of the grid supports 21 by means of hinge pins 49. Each hinge member 48 has a pin 50 extending laterally from the hinge member but displaced vertically from the hinge pin 49. Each pin 50 engages with the elongated slot 37 in the end of the associated grid support 21. It will be appreciated that the ring members adjacent the periphery of the skirt will be shaped to conform to the areas enclosed by the skirt and the grip supports 21.

By arranging that the hinge members 34, 48 are pivoted at a location above the pins 36, 50 supporting the grid supports 21, the grid supports 21 will tend to be in their lowest position when the assembly is assembled at ambient temperature and differential thermal expansion will cause pivoting of the hinge members 34, 48 with consequent lateral movement

accompanied by slight raising of the grid supports 21. On cooling and contraction of the assembly, the hinge members will thus tend to revert towards their lowest position.

In an alternative embodiment, as shown in Figures 11, 12 and 13, a simpler construction may be employed, omitting the hinge members. In this embodiment, each grid support 21 has a projecting notched lug 51 at each end which engages in an elongated slot or notch 52 in the outer upstand 31 of the base member 28 and the inner upstand is omitted. Similarly at the periphery of the skirt, the lugs 51 engage with slots or notches 53 in the brackets 47 fastened to the lower portion 17 of the skirt. The grid supports 21 are thus free to expand longitudinally and to move laterally in the slots 52 and 53. In this embodiment the octagonal ring member is omitted and the cross bars 42 are mounted in notches 54 in the upper surface of the grid supports 36. The ends of the cross bars 42 are provided with notches 55 which engage with the notches 54 in the grid supports. On thermal expansion or contraction of the cross bars 42, the grid supports 21 are thus moved laterally in slots or notches 52, 53. By virtue of the notches 55, on contraction on cooling, the grid supports tend to return to their cold, undisplaced position.

It will be appreciated that the whole supporting assembly can be constructed simply by supporting the base members 28 (having the tie rods 27 extending upwardly therefrom) and skirt 15 (having its channel section supports 18 and flanges 47 welded or otherwise fastened thereto) on a suitable substrate: the grid supports 21 (and, if used, hinge members 34, 48) are then located on the base members 28 and flanges 47. The octagonal rings 38 (if used) are then positioned on the grid supports 21 and cross bars 42 located in the appropriate notches 41 or 54. The rods 44 are then positioned in the notches 43 in the cross bars 42, cover plates 29 positioned and then the wire mesh 46, having holes at intervals for the tie rods 27, is laid over the rods 44 and cover plates 29. The wire mesh, preferably in a single piece, extends all over the area of the skirt and may be fastened to the periphery thereof, e.g. by welds, if desired. The catalyst, which may be a wad of wire gauzes or particulate, is then disposed above the mesh 46. The brackets 26, serpentine tube 24 and primary support members 19 are then positioned on the tie rods 27 with the primary support members 19 resting in the channel section supports 18. A nut 56 (See Figure 3) is then applied to the upper end of each tie rod 27. The skirt 15 carrying the whole assembly can then be lifted and placed in the reactor.

In the embodiment described above, the catalyst bed is heated to the ignition temperature by combusting a gas supplied via the serpentine tube 24. While this allows all of the bed to be heated simultaneously, this arrangement may present practical difficulties in view of the relatively large amount of fuel gas, e.g. hydrogen required. An alternative arrangement is to heat the sections of the bed in turn. This may be achieved by replacing the serpentine tube by a number of separate tubes parallel with each primary support member with means to

isolate each tube from the gas supply except when it is desired to heat the section of the catalyst bed below that tube.

In another arrangement the primary support members may be disposed radially, instead of parallel to one another, thus providing sectors of the lattice assembly that are free from tie rods. In this case the primary support members may be displaced vertically relative to one another so that they cross over one another at the centre of the apparatus. In this way the need for a welded junction member at the centre can be avoided. The start-up heater can then be in the form of a plurality of radially extending burner tubes having a plurality of perforations disposed so that a flame can be directed down from the tube or tubes on to the catalyst bed, and means are provided to oscillate the radially extending burner tubes about the longitudinal axis of the apparatus below the primary support members across the sectors between the tie rods. The radially extending burner tubes are supplied with the fuel gas from a central supply pipe.

Alternative, preferred, start-up burner arrangements are shown in the embodiments of Figures 14 and 15. In the arrangement of Figure 14, which is a view similar to that of Figure 3 with the base assembly 20 shown dotted, the serpentine tube 24 and its support brackets 26 are omitted and the tie rods 27 are hollow for part of their length. Radial holes 57 are bored at a suitable location above the catalyst bed to communicate with the hollow interior 58 of the tie rods 27 and so provide burner orifices. To effect start-up, a fuel gas, e.g. hydrogen, is supplied to the upper end of the hollow interior 58 of the tie rod by means not shown and flows down through the hollow interior of the tie rod and emerges through the burner orifices where it combusts to provide a flame to heat the catalyst bed.

It will be appreciated that the tie rod may be a tube with a suitable cap or plug at its lower end. Alternatively each tie rod may be constructed in sections; for example a solid rod lower section and an upper tubular section and these may be welded or screw-threaded together.

In the arrangement of Figure 15, which is similar to Figure 14 but showing just the upper part of the tie rod assembly, each tie rod is provided, above the catalyst bed, with a burner assembly in the form of an enclosure in the form of a hollow cylindrical casing 59 provided with perforations 60 at suitable locations to form burner orifices and a fuel gas feed tube 61.

It will be appreciated that in the arrangements of Figures 14 and 15, the burner orifices may be inclined to direct the flame down on to the catalyst bed if desired. Where the base assemblies 20 and tie rods 27 are disposed in a square configuration, as in Figure 2, each tie rod may be provided with four burner orifices directed towards the tie rod that is disposed diagonally opposite in the aforesaid square configuration. It will also be appreciated that in some cases it may not be necessary to provide each tie rod with a burner arrangement: for

example alternate tie rods may be so provided. A suitable igniter, e.g. a spark plug, (not shown), may be provided to effect ignition of the fuel. Since the flame can propagate from one burner to another, it is not necessary to provide each burner with such ignition means.

5 The catalyst may be, as mentioned above, a wad of meshes or gauzes of a precious metal, e.g. platinum alloyed with rhodium, or alternatively may be a fixed bed of a particulate catalyst for example a rare earth/cobalt oxides composition as described in our WO 98/28073.

Claims.

1. A structure for supporting a catalyst bed in a vessel comprising a series of primary supports extending across the vessel and a lattice assembly carrying the catalyst bed disposed beneath the primary supports and suspended therefrom via suspending means extending through the catalyst bed.
2. A structure according to claim 1 wherein the primary supports extend chordally across the vessel.
3. A structure according to claim 1 or claim 2 wherein the lattice assembly comprises a plurality of secondary support assemblies and a plurality of grid assemblies carried by the secondary support assemblies.
4. A structure according to claim 3 wherein a number of secondary support assemblies are suspended from each primary support by tie rods.
5. A structure according to claim 4 wherein the secondary support assemblies are disposed in a square configuration.
6. A structure according to claim 4 or claim 5 wherein the secondary support assemblies comprises base members connected by of pairs of grid supports supported by the base members and capable of longitudinal and lateral movement relative to one another and relative to the base members.
7. A structure according to claim 6 the grid supports are supported by pins to hinge members pivoting in the base members about an axis parallel to, but above, said pins.
8. A structure according to claim 6 or claim 7 wherein a grid assembly is supported by the inner one of each pair of grid supports connecting adjacent base members.
9. A structure according to claim 8 wherein the grid assembly comprises members extending across the area enclosed by said inner grid supports but free to move longitudinally relative thereto.
10. A structure according to claim 9 wherein said grid assembly includes a ring member engaging with said inner grid supports, and said members extending across the area

enclosed by said inner grid supports are located in notched in the upper surface of said ring member.

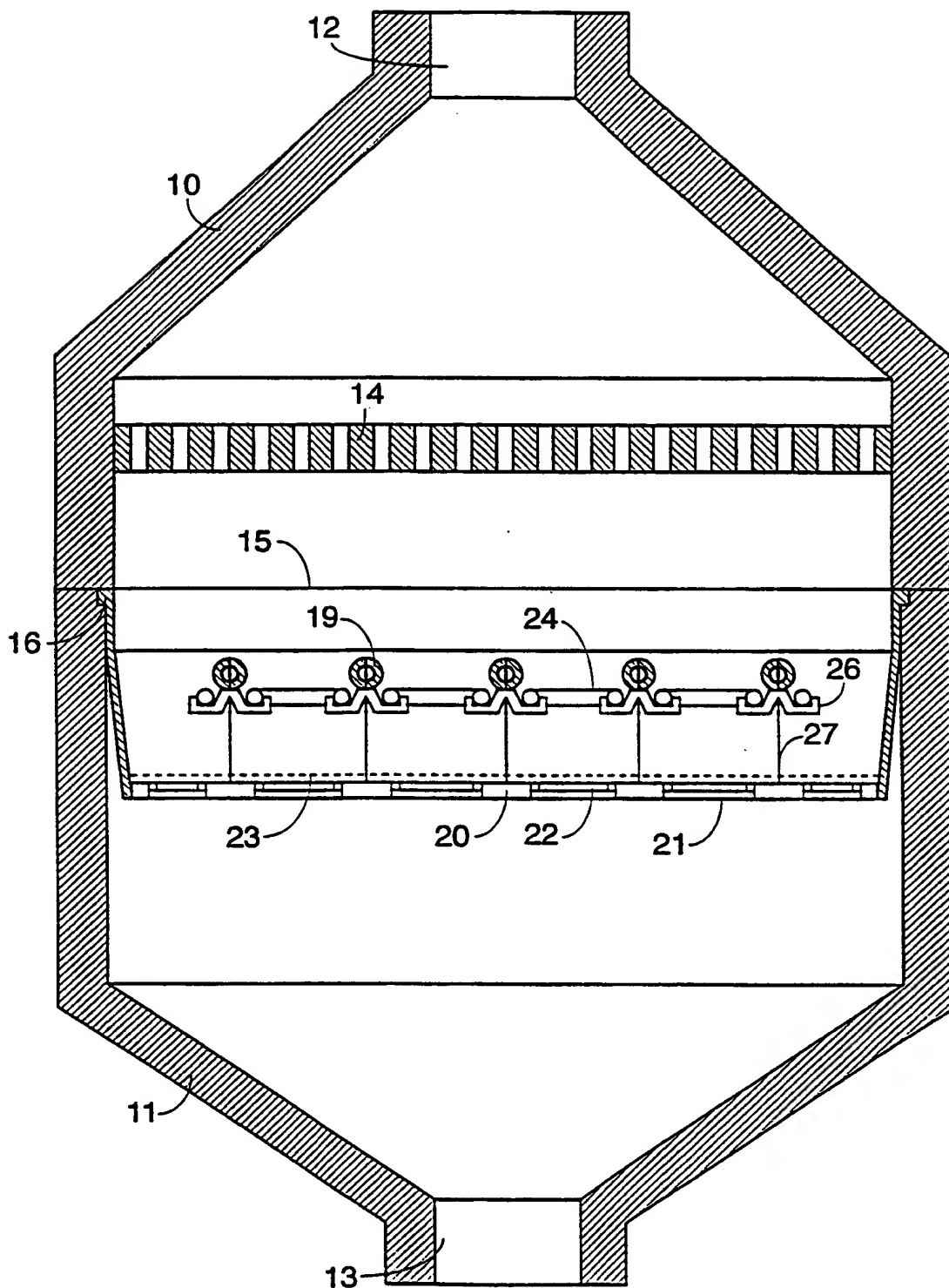
11. A structure according to any one of claims 1 to 9 for use for the oxidation of ammonia wherein the catalyst bed comprises a wad of gauzes or meshes of a precious metal.
12. A structure according to any one of claims 1 to 9 for use for the oxidation of ammonia wherein the catalyst bed comprises a fixed bed of particles of a rare earth/cobalt oxides composition.
13. A structure according to claim 1 wherein the primary support members are disposed radially.
14. A structure according to any one of claims 1 to 13 including a static start-up burner arrangement in the form of one or more perforate tubes adjacent the primary supports and means to supply a combustible gas to said tube or tubes, the perforations in said tube or tubes being disposed so that a flame can be directed down from the tube or tubes on to the catalyst bed.
15. A structure according to claim 14 wherein said start-up burner comprises a single perforate tube disposed adjacent the primary supports in a serpentine configuration.
16. A structure according to any one of claims 1 to 13 wherein the suspending means comprises tie rods and at least some of which are provided with a start-up burner arrangement.
17. A structure according to claim 16 wherein at least some of the tie rods are hollow and have radial holes therein and means are provided to supply a fuel gas to the interior of said hollow tie rods.
18. A structure according to claim 16 wherein at least some of the tie rods are provided with an enclosure surrounding the tie rod for at least part of its length, said enclosure being provided with burner orifices and means to supply a fuel gas to said enclosure.
19. A structure according to claim 13 including a start-up burner arrangement in the form of a plurality of radially extending burner tubes one for each sector, each tube having a plurality of perforations disposed so that a flame can be directed down from the tube or

tubes on to the catalyst bed, and means are provided to oscillate the radially extending burner tubes about the longitudinal axis of the apparatus below the primary support members.

20. A structure according to any one of claims 1 to 19 wherein said primary supports are carried by a skirt member located round the interior periphery of the vessel.
21. A structure according to claim 20 wherein the lower portion of the skirt member is of frusto-conical configuration, and the lattice assembly is attached at intervals to said lower portion.

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Fig.1.



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Fig.3.

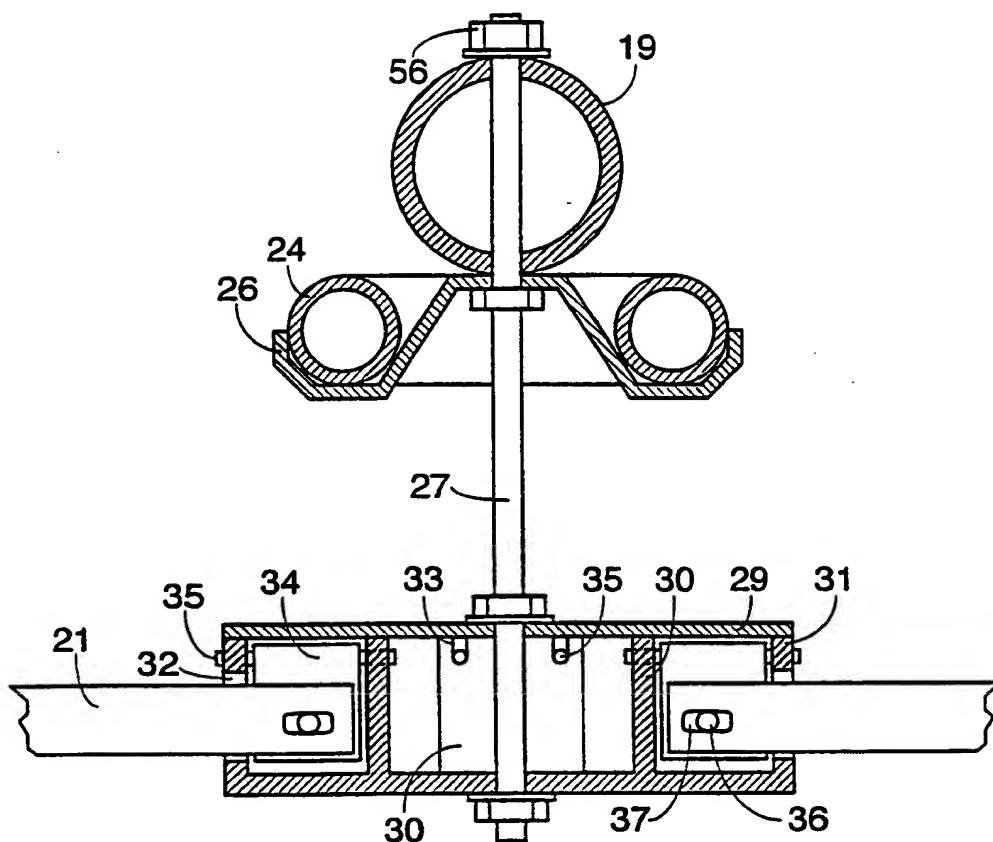
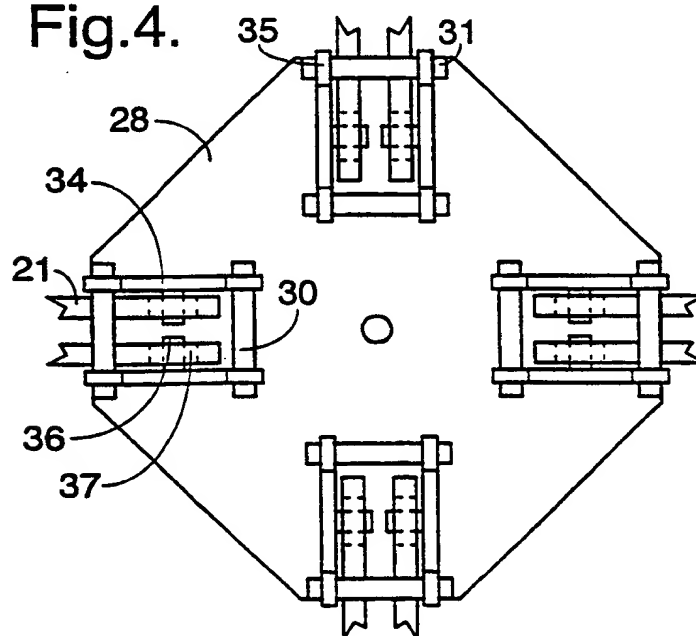


Fig.4.



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Fig.5.

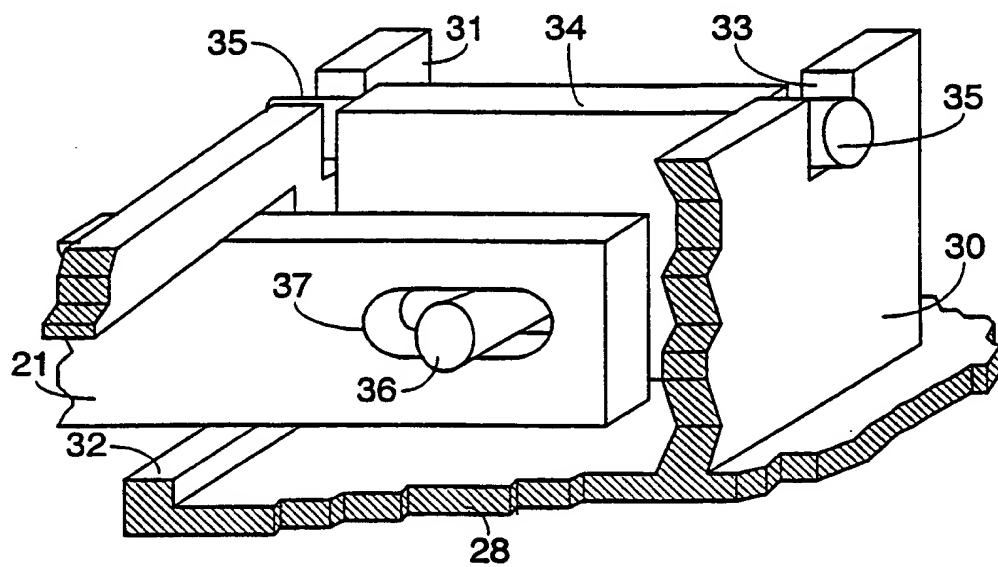
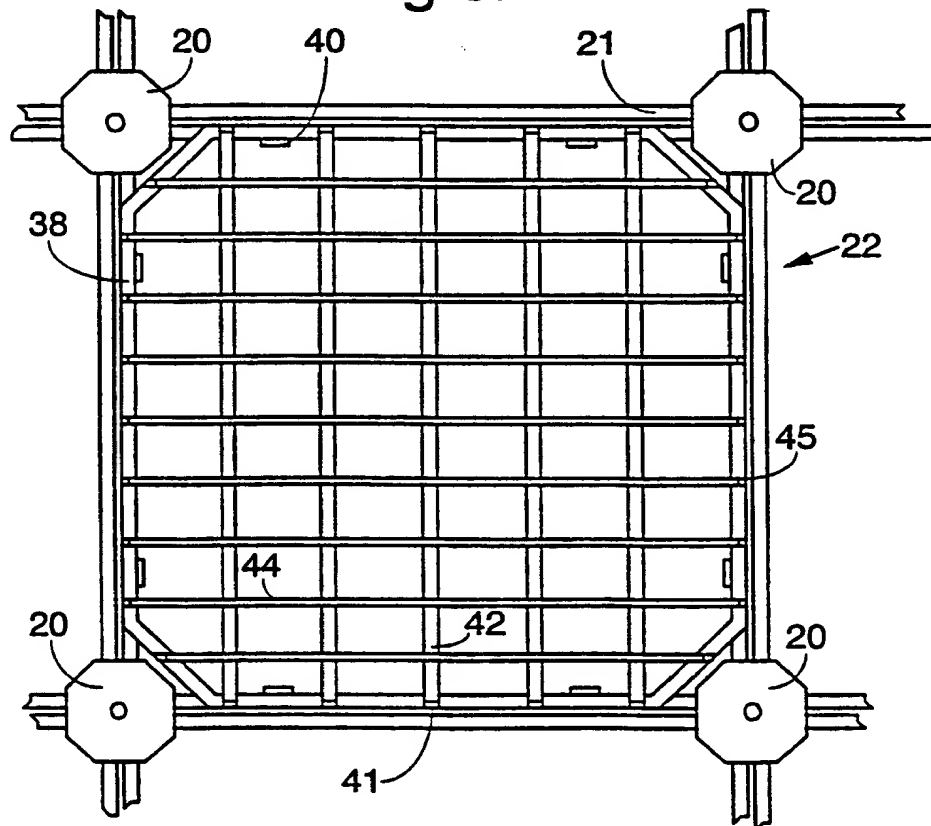


Fig.6.



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Fig.7.

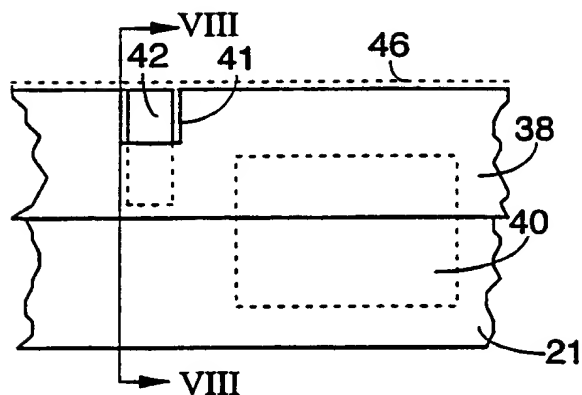


Fig.8.

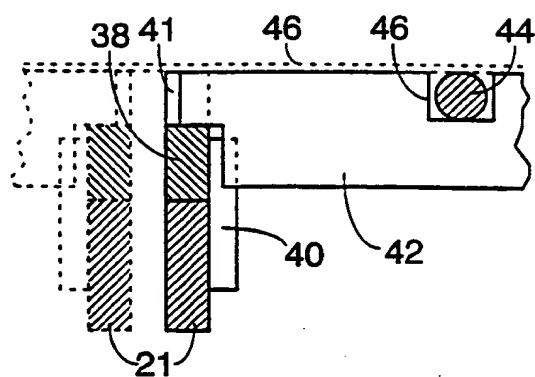


Fig.9.

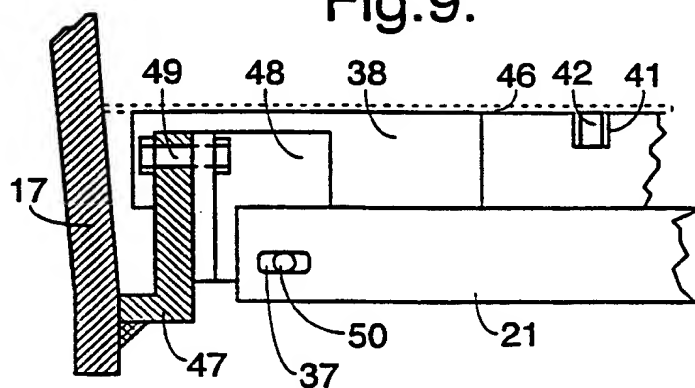
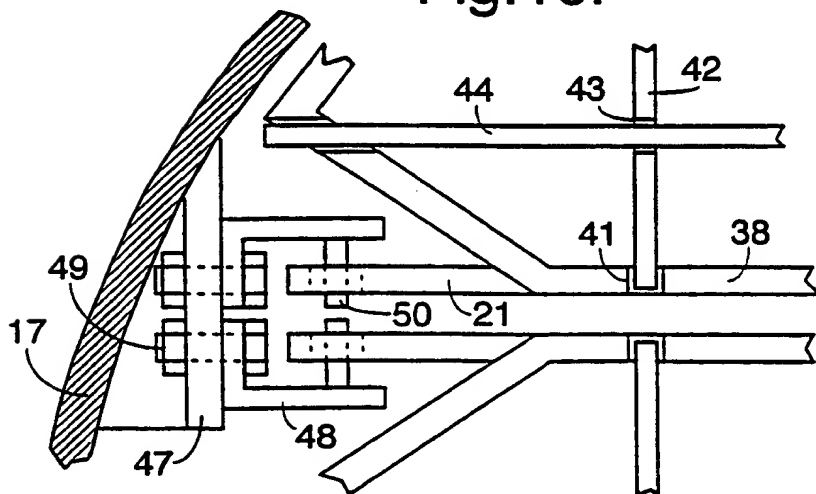


Fig.10.



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Fig.11.

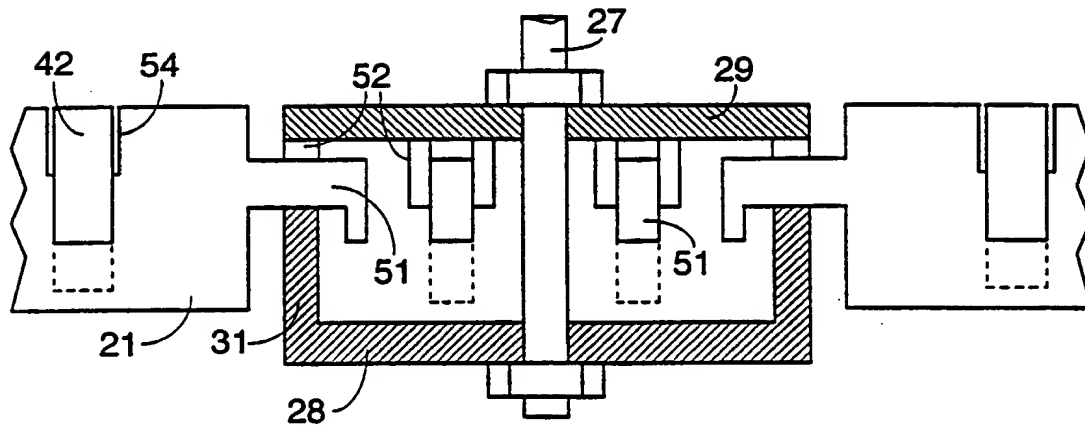


Fig.12.

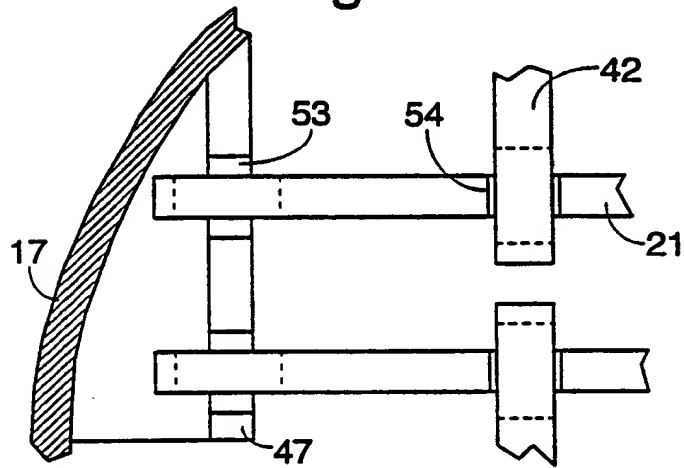
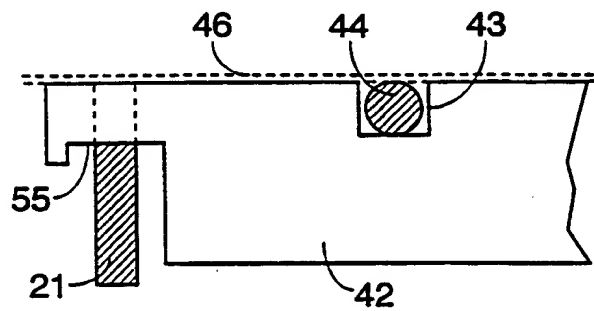


Fig.13.



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Fig.14.

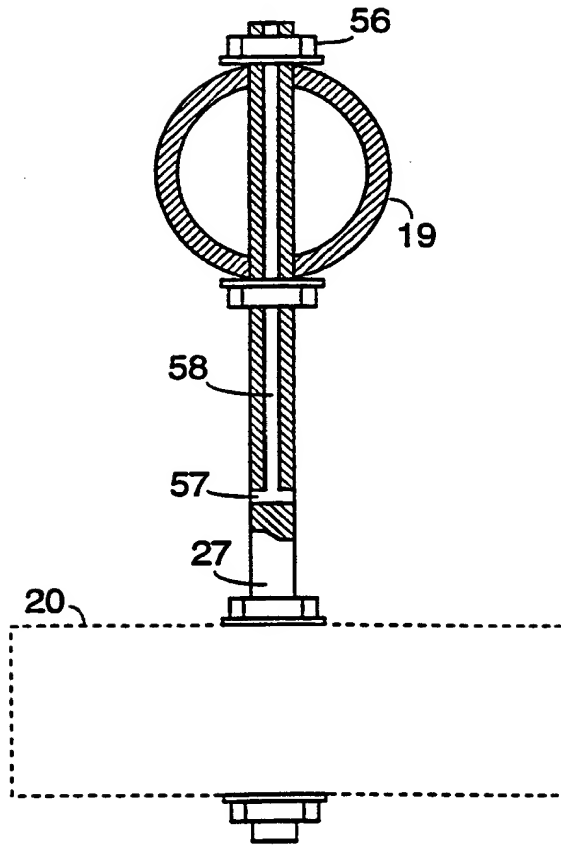
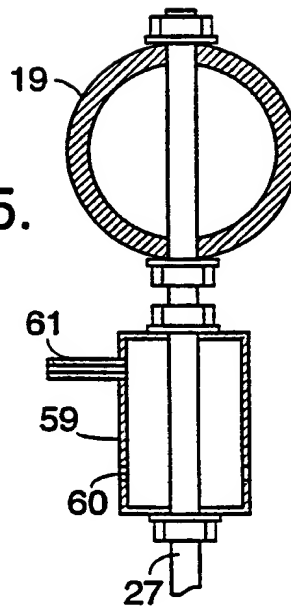


Fig.15.



INTERNATIONAL SEARCH REPORT

Intern. Natl Application No

PCT/GB 99/04188

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B01J8/02 B01J8/00 C01B21/26 C01B21/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B01J C01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 482 946 A (SHIRK ROBERT M) 9 December 1969 (1969-12-09) column 3, line 16 - line 50 claims 1-7; figures 1-5 ----	1-4, 14, 15, 20
A	US 4 195 064 A (BETTEKEN JOSEPH C ET AL) 25 March 1980 (1980-03-25) column 5, line 60 - column 8, line 37 claims 1-7; figures 5-10 ----	1, 3-6
A	FR 2 253 554 A (BRITISH PETROLEUM CO) 4 July 1975 (1975-07-04) page 5, line 33 - page 7, line 15 figures 1-4 ----	1, 14
A	DE 37 31 988 A (STEINMUELLER GMBH L & C) 6 April 1989 (1989-04-06) the whole document -----	11, 12



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

21 March 2000

Date of mailing of the international search report

29/03/2000

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. Appl. No.

PCT/GB 99/04188

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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DE 3731988	A	06-04-1989	NONE		

09/869934
JUL 09 2001
Rec'd PCT/PTO
APPLICATION UNDER UNITED STATES PATENT LAWS

Atty. Dkt. No. PW 281360
(M#)

Invention: CATALYST SUPPORT

Inventor (s): DAVIES

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This is a:

- ☐ Provisional Application
- ☐ Regular Utility Application
- ☐ Continuing Application
☒ The contents of the parent are incorporated by reference
- ☒ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application
- ☐ Substitute Specification
Sub. Spec Filed _____
in App. No. _____ / _____
- ☐ Marked up Specification re
Sub. Spec. filed _____
In App. No. _____ / _____

SPECIFICATION

Abstract

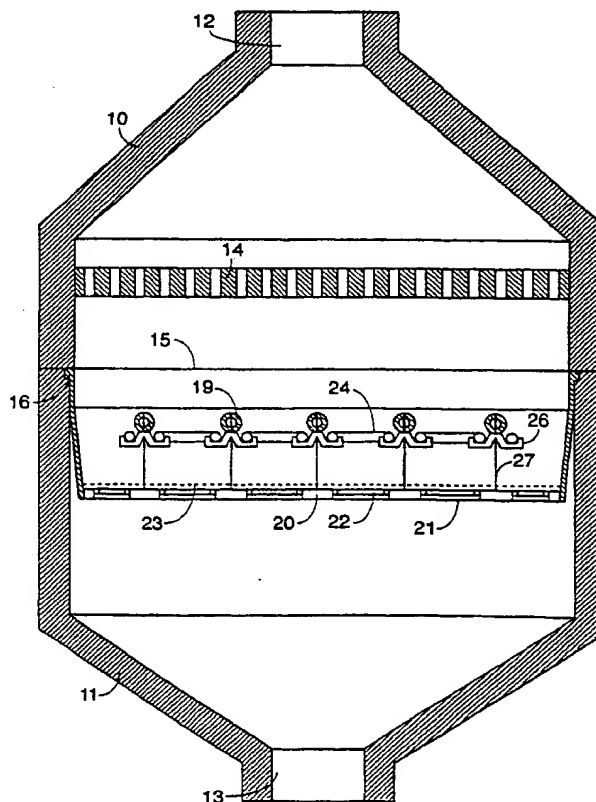
A catalyst support structure e.g. for use in an ammonia oxidation reactor, comprising a series of primary supports disposed above a catalyst bed, a lattice assembly disposed beneath the catalyst bed and on which the catalyst bed rests, said lattice assembly being suspended from the primary supports by suspending means extending through the catalyst bed. Preferably the support structure includes a static start-up burner arrangement in the form of one or more perforated tubes adjacent to the primary supports.

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : B01J 8/02, 8/00, C01B 21/26, 21/28	A1	(11) International Publication Number: WO 00/40329 (43) International Publication Date: 13 July 2000 (13.07.00)
(21) International Application Number: PCT/GB99/04188 (22) International Filing Date: 10 December 1999 (10.12.99) (30) Priority Data: 9900314.7 8 January 1999 (08.01.99) GB (71) Applicant (for all designated States except US): IMPERIAL CHEMICAL INDUSTRIES PLC [GB/GB]; Imperial Chemical House, Millbank, London SW1P 3JF (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): DAVIES, Raymond [GB/GB]; 9 Limpton Gate, Yarm, Cleveland TS15 9JA (GB). (74) Agents: GRATWICK, Christopher et al.; ICI Group Intellectual Property, P.O. Box 90, Wilton, Middlesbrough, Cleveland TS90 8JE (GB).		(81) Designated States: AU, BR, CA, CN, IN, JP, KR, NO, RU, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: CATALYST SUPPORT**(57) Abstract**

A catalyst support structure e.g. for use in an ammonia oxidation reactor, comprising a series of primary supports (19) disposed above a catalyst bed, a lattice assembly disposed beneath the catalyst bed and on which the catalyst bed rests, said lattice assembly being suspended from the primary supports (19) by suspending means (27) extending through the catalyst bed. Preferably the support structure includes a static start-up burner arrangement in the form of one or more perforated tubes (24) adjacent the primary supports (19).



Abstract

A catalyst support structure e.g. for use in an ammonia oxidation reactor, comprising a series of primary supports disposed above a catalyst bed, a lattice assembly disposed beneath the catalyst bed and on which the catalyst bed rests, said lattice assembly being suspended from the primary supports by suspending means extending through the catalyst bed. Preferably the support structure includes a static start-up burner arrangement in the form of one or more perforated tubes adjacent to the primary supports.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receipt of Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) CPW 50721/WO

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CATALYST SUPPORT

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for the purposes of:

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States

☒ all designated States except
the United States of America

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☐ applicant only

☒ applicant and inventor

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- ☐ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|---|---|
| <input type="checkbox"/> AE United Arab Emirates | <input type="checkbox"/> LR Liberia |
| <input type="checkbox"/> AL Albania | <input type="checkbox"/> LS Lesotho |
| <input type="checkbox"/> AM Armenia | <input type="checkbox"/> LT Lithuania |
| <input type="checkbox"/> AT Austria | <input type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input type="checkbox"/> LV Latvia |
| <input type="checkbox"/> AZ Azerbaijan | <input type="checkbox"/> MD Republic of Moldova |
| <input type="checkbox"/> BA Bosnia and Herzegovina | <input type="checkbox"/> MG Madagascar |
| <input type="checkbox"/> BB Barbados | <input type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input type="checkbox"/> BG Bulgaria | |
| <input checked="" type="checkbox"/> BR Brazil | <input type="checkbox"/> MN Mongolia |
| <input type="checkbox"/> BY Belarus | <input type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> CA Canada | <input type="checkbox"/> MX Mexico |
| <input type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CN China | <input type="checkbox"/> NZ New Zealand |
| <input type="checkbox"/> CU Cuba | <input type="checkbox"/> PL Poland |
| <input type="checkbox"/> CZ Czech Republic | <input type="checkbox"/> PT Portugal |
| <input type="checkbox"/> DE Germany | <input type="checkbox"/> RO Romania |
| <input type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> RU Russian Federation |
| <input type="checkbox"/> EE Estonia | <input type="checkbox"/> SD Sudan |
| <input type="checkbox"/> ES Spain | <input type="checkbox"/> SE Sweden |
| <input type="checkbox"/> FI Finland | <input type="checkbox"/> SG Singapore |
| <input type="checkbox"/> GB United Kingdom | <input type="checkbox"/> SI Slovenia |
| <input type="checkbox"/> GD Grenada | <input type="checkbox"/> SK Slovakia |
| <input type="checkbox"/> GE Georgia | <input type="checkbox"/> SL Sierra Leone |
| <input type="checkbox"/> GH Ghana | <input type="checkbox"/> TJ Tajikistan |
| <input type="checkbox"/> GM Gambia | <input type="checkbox"/> TM Turkmenistan |
| <input type="checkbox"/> HR Croatia | <input type="checkbox"/> TR Turkey |
| <input type="checkbox"/> HU Hungary | <input type="checkbox"/> TT Trinidad and Tobago |
| <input type="checkbox"/> ID Indonesia | <input type="checkbox"/> UA Ukraine |
| <input type="checkbox"/> IL Israel | <input type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IN India | <input checked="" type="checkbox"/> US United States of America |
| <input type="checkbox"/> IS Iceland | |
| <input checked="" type="checkbox"/> JP Japan | <input type="checkbox"/> UZ Uzbekistan |
| <input type="checkbox"/> KE Kenya | <input type="checkbox"/> VN Viet Nam |
| <input type="checkbox"/> KG Kyrgyzstan | <input type="checkbox"/> YU Yugoslavia |
| <input type="checkbox"/> KP Democratic People's Republic of Korea | <input type="checkbox"/> ZA South Africa |
| <input checked="" type="checkbox"/> KR Republic of Korea | <input type="checkbox"/> ZW Zimbabwe |
| <input type="checkbox"/> KZ Kazakhstan | |
| <input type="checkbox"/> LC Saint Lucia | |
| <input type="checkbox"/> LK Sri Lanka | |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

Supplemental Box If the Supplemental Box is not used, this sheet should not be included in the request.

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

- (i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;
- (ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;
- (iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;
- (iv) if, in addition to the agent(s) indicated in Box No. II, there are further agents: in such case, write "Continuation of Box No. II" and indicate for each further agent the same type of information as required in Box No. II;
- (v) if, in Box No. I, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. I, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. I" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;
- (vi) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;
- (vii) if, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.

2. If, with regard to the precautionary designation statement contained in Box No. I, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.

3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial disclosures or exceptions to lack of novelty: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.

CONTINUATION OF BOX NO. IV

GRAHAM, John George
 GRATWICK, Christopher
 GIBSON, Sara Hillary Margaret
 HUMPHRIES, Martyn
 ROBERTS, Jonathan Winstanley

Box No. VI PRIORITY CLAIM☐ Further priority claims as indicated in the Supplemental Box.

Filing date of earlier application (day: month: year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 8.1.99 8 January 1999	9900314.7	GB		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): (1)

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA)
(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day: month: year)

Number

Country (or regional Office)

ISA /

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request : 4
description (excluding
sequence listing part) : 8
claims : 3
abstract : 1
drawings : 7
sequence listing part
of description : _____

Total number of sheets : 23

This international application is accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☒ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☒ other (specify): Form 23/77

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).



GRATWICK, Christopher
Agent

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	
6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only

Date of receipt of the record copy
by the International Bureau:

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International application No.

Date stamp of the receiving Office

Applicant's or agent's
file reference

CPW 50721/WO

Applicant

IMPERIAL CHEMICAL INDUSTRIES PLC

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE 55.00 ☐ T

2. SEARCH FEE 638.00 ☐ S

International search to be carried out by

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

The international application contains 23 sheets.

first 30 sheets 285.00 ☐ b1

remaining sheets x additional amount = ☐ b2

Add amounts entered at b1 and b2 and enter total at B 285.00 ☐ B

Designation Fees

The international application contains 11 designations.

10 x 65 = 650.00 ☐ D

number of designation fees payable (maximum 10) amount of designation fee

Add amounts entered at B and D and enter total at I 935.00 ☐ I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT (if applicable) 22.00 ☐ P

5. TOTAL FEES PAYABLE 1650.00

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☒ authorization to charge
deposit account (see below)

☐ cheque

☐ postal money order

☐ bank draft

☐ cash

☐ revenue stamps

☐ coupons

☐ other (specify):

DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)

The RO/ 101 ☒ is hereby authorized to charge the total fees indicated above to my deposit account.

☒ (this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☒ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

DO 2887

8 December 1999

Deposit Account No.

Date (day/month/year)

Signature

POWER OF ATTORNEY CONCERNING
GIVEN INTERNATIONAL APPLICATION
PATENT COOPERATION TREATY


The undersigned applicants IMPERIAL CHEMICAL INDUSTRIES PLC of Imperial Chemical House, Millbank, London, SW1P 3JF, United Kingdom and RAY DAVIES, hereby appoint;

GRAHAM DONALD ARNOLD
SARA HILLARY MARGARET GIBSON
JOHN GEORGE GRAHAM
CHRISTOPHER GRATWICK
MARTYN HUMPHRIES
JONATHAN WINSTANLEY ROBERTS
IEUAN THOMAS

as Agent to act on their behalf before the competent International Authorities in connection with the International application concerning

CATALYST SUPPORT

Case No CPW 50721/WO, filed with the United Kingdom Patent Office and to make or receive payments on their behalf.



RAYMOND DAVIES
Place: *Billingham, Cleveland.*
Date: *13/11/89.*

IMPERIAL CHEMICAL INDUSTRIES PLC



CHRISTOPHER GRATWICK
EMPOWERED TO SIGN ON BEHALF OF IMPERIAL CHEMICAL INDUSTRIES PLC

Place: Wilton, Middlesbrough, Cleveland

Date: *6 Dec 1999.*

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 06 OCT 2000

WIPO PCT

Applicant's or agent's file reference ./.	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/04188	International filing date (day/month/year) 10/12/1999	Priority date (day/month/year) 08/01/1999
International Patent Classification (IPC) or national classification and IPC B01J8/02		
Applicant IMPERIAL CHEMICAL INDUSTRIES PLC et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 4 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 17/07/2000	Date of completion of this report 04.10.2000
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Piber-Goldbacher, U Telephone No. +49 89 2399 7327



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/04188

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

Description, pages:

1-8 as originally filed

Claims, No.:

1-21 as originally filed

Drawings, sheets:

1/7-7/7 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/04188

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-21
	No: Claims
Inventive step (IS)	Yes: Claims 1-21
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-21
	No: Claims

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: US-A-4 195 064 (BETTEKEN JOSEPH C ET AL) 25 March 1980 (1980-03-25)

Prior Art:

D1 discloses a structure for supporting a catalyst bed, comprising vertical columns whereto horizontal beams are attached. Said beams are carrying the catalyst support grid.

Novelty:

The subject-matter of independent claim 1 is novel, because none of the available prior art documents discloses a lattice assambly that is suspended from a primary support.

Inventive Step:

The effect of the suspended lattice is, that the primary support is situated above the catalyst bed. The problem to be solved by the subject-matter of claim 1 is therefore to provide a catalyst support that is not exposed to the high temperatures occurring in the reaction region. The subject-matter of independent claim 1 is inventive, because it solves the aforementioned technical problem in a way that has not yet been disclosed in the prior art.